Radar and Disdrometer Comparisons at NASA Wallops Flight Facility

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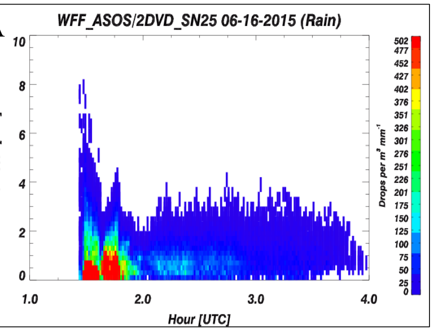
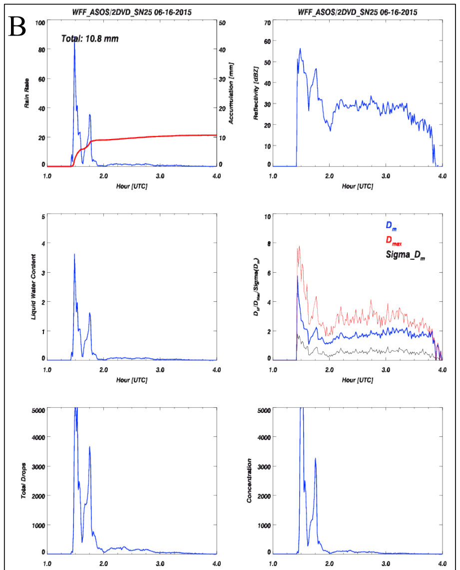
Introduction

GPM deploys a large network of rain gauges, disdrometers, rain profilers and radars at Wallops Flight Facility. A major effort is underway to study the horizontal and vertical variability of precipitation in order to better parameterize and mitigate Non-Uniform Beam Filling (NUBF) of satellite footprint observations. We present a case study of the vertical variability of radar reflectivity [dBZ], mass-weighted mean diameter (D_M) and normalized slope intercept N_W using vertical profiles obtained with NASA's S-band, dual-polarization (NPOL) radar and use 2DVD data to help validate our results.

A



B



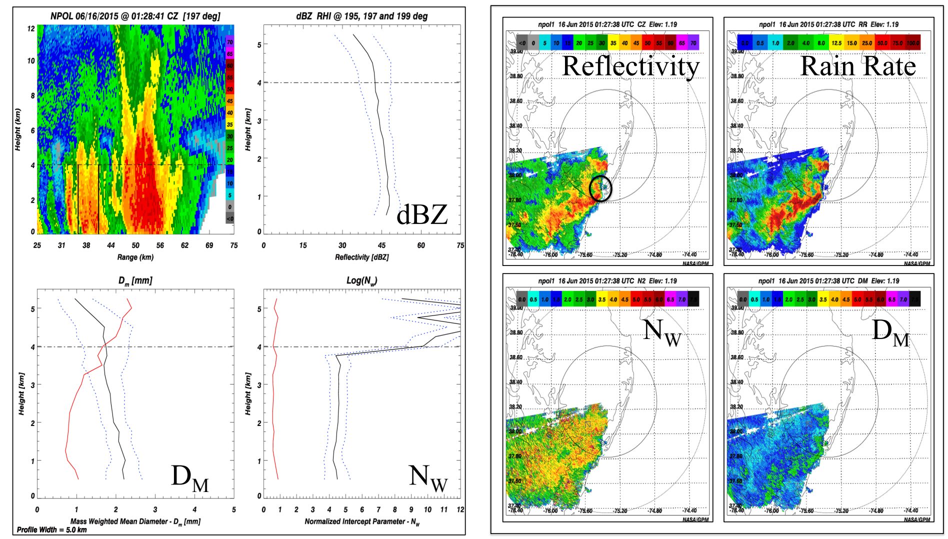
Case Study: June 16, 2015

- Panel A shows the DSD plot obtained from a 2DVD instrument located at Wallops (SN25). The onset of precipitation (0128 UTC) shows a small number of large (6-8 mm) drops.
- Panel B shows (from left to right and top to bottom) the resultant rain rate, reflectivity, liquid water content, drop size [D_M, D_{Max} and $\sigma(D_M)$], total drops and concentrations. The initial burst of rain exceeded 80 mm hr^{-1} and was associated with very large drops.
- Panels C & D shows the RHI and retrieved vertical profiles of reflectivity, D_M and $\log(N_W)$. On the right side of panel C, PPI sectors show the overall pattern of precipitation near the time of the RHI via horizontal fields of reflectivity, rain rate, N_W and D_M. The blue dotted line show the mean profile value +/- one standard deviation. The red line shows the coefficient of variation [COV = σ/Mean]

Comments

- Convective case shows mean near-surface reflectivity approximately 45 dB, while stratiform is approximately 30 dB.
- Variance of reflectivity much higher in convective case and increases near FL while reduced variance is seen in stratiform case with little or no height dependence.
- Mean and standard deviation of D_M in convection slightly higher than in stratiform precipitation.
- Mean N_W in stratiform nearly two orders of magnitude lower than in convection.
- Below FL, little height dependency for N_W shown in either case.
- Slope of dBZ profile is negative for convection and slightly positive for stratiform.
- Slope of D_M profile is slightly negative for convection, but near zero for stratiform.
- Overall, convective case is characterized by high reflectivity (> 45 dB), intense rain rates (> 50 mm hr^{-1}), large N_W and moderate D_M (3 mm), while stratiform case is characterized by moderate reflectivity (30 dB) and rain rates (< 5 mm hr^{-1}), small N_W and small D_M.
- Although magnitudes vary, both 2DVD and radar show similar characteristics in both convective and stratiform periods. Interesting also that several other 2DVDs observed the large drops (> 6 mm) at precipitation onset.

C Convective: 06/16/2015 @ 0128 UTC



1) Dashed line at ~ 4 km is the freezing level obtained from WFF sounding.
2) The vertical bars between 36-40 km in RHI represent the range that is being profiled.
3) The black circle in the dBZ PPI plots shows the general location of WFF where five 2DVD are deployed.
4) Panel C shows the onset of precipitation as a convective core is directly over Wallops.
5) Panel D shows the same system nearly two hours later as stratiform rain with a well-defined bright band.
6) All retrievals above FL should be ignored.

D Stratiform: 06/16/2015 @ 0313 UTC